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ABSTRACT

A study examined the possibility of using kindergarten screening scores to predict whether a student would qualify for the reading intervention program in first grade. A total of 243 students were selected from the 7 Ashland, Ohio, elementary schools. The scores for 121 students were subjected to logit regression analysis. The remaining 122 students were used as a holdout group for the purpose of cross-validating the logit regression model's ability to correctly classify students. The results indicated that the ABC Inventory (Adair and Blesch, 1965) scores were the most important scores to consider when classifying students. The logit regression model was better able to correctly identify students who did not qualify for the program than students who did qualify. It was recommended that if correctly identifying approximately one-half of the students who would eventually qualify for assistance was sufficient, the model could be used. If a higher level of accuracy were required, other types of information, such as the kindergarten teachers' evaluations of students might improve the model's ability to identify students. (Four tables of data are included; 27 references are attached.) (Author/PRA)

The Use of Kindergarten Screening Scores to Identify the Need for Reading Intervention: A Logit Regression Study

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Running head: KINDERGARTEN SCREENING SCORES

The Use of Kindergarten Screening Scores to Identify the Need for Reading Intervention: A Logit Regression Study

Abstract

The purpose of this study was to examine the possibility of using the kindergarten screening scores to predict whether a student would qualify for the reading intervention program in first grade.

A total of 243 students were selected from the seven Ashland, Ohio, elementary schools. The scores for 121 students were subjected to logit regression analysis. The remaining 122 students were used as a holdout group for the purpose of cross-validating the logit regression model's ability to correctly classify students.

The results indicated that the ABC Inventory scores were the most important scores to consider when classifying students. The logit regression model was better able to correctly identify students who did not qualify for the program than those students who did qualify. It was recommended that if correctly identifying approximately one half of the students who would eventually qualify for assistance was sufficient, the model could be used. If a higher level of accuracy was required other types of information, such as the kindergarten teachers' evaluations of students may improve the model's ability to identify students.

Introduction

If all children began school on the same level we could conceivably move everyone along at approximately the same rate and successfully graduate all the children together after 13 years. The truth is, however, as children enter kindergarten they bring many different levels of knowledge, learning styles and even ages. Meeting the individual needs of every child becomes a more difficult task as greater and greater demands are placed on meeting that objective. This fact identifies a very serious dilemma.

Children who do not learn to read by the end of first grade will fail to achieve in almost all other areas of the curriculum (Boehnlein 1987). The Ashland City Schools have several early intervention programs and other special instruction programs to try to meet the various needs of all their students. For many children, regular classroom instruction is all that is needed, but experience in regular classrooms alone is not sufficient for many other students. This study attempted to use kindergarten screening scores to determine if those scores would allow educators to

identify which students would qualify for a reading intervention program in first grade. If such predictions could accurately be made, the school administrators wanted to develop an intervention program that could be implemented before the students reached first grade.

This study used logit regress on analysis to determine if the students' kindergarten screening scores could be used to accurately predict who will qualify for reading intervention in first grade.

Review of the Literature

In current literature, a debate has continued on the use of kindergarten screening instruments. Titles such as: "Not Ready! Don't Rush Me!" (Hammond, 1986); "Uses and Abuses of Developmental Screening and School Readiness Testing" (Meisels, 1987); and "How Best to Protect Children From Inappropriate School Expectations, Practices, and Policies: (Bredekamp & Shepard, 1989), point out the controversy surrounding the current uses of kindergarten screening procedures.

Some educators are dealing with issues that may lead to a reduction in unhappy children, special needs children, and children placed in the wrong grade.

Other educators and researchers are trying to stop the negative effects of labeling, retention, and escalation of the curriculum (Bredekamp & Shepard, 1989; Hammond, 1986). The very practice of testing groups of young children is questioned in various articles (Charlesworth, 1989; Wodtke, Harper, Schommer & Brunelli, 1989). The reliability and validity of screening instruments are major concerns that have been noted by several researchers (Wodtke, Harper, Schommer & Brunelli, 1989; Bredekamp & Shepard, 1989; Meisels, 1987).

Screening batteries differ widely in scope and purpose. On a predictive level, low screening scores will raise questions about a student meeting school expectations. On a descriptive level, the screening presents a picture of the child's development and on an intervention level the screening may point out the need for further assessment (Ireton, Shing-Lun & Kampen, 1981).

At its best, kindergarten screening is a brief assessment procedure designed to identify those children who need a more intensive level of diagnostic assessment. It is the first step in evaluation,

prevention, and intervention (Meisels, 1985). Kindergarten screening at its worst produces comments such as; "We cannot support policies such as readiness testing, transition classes, holding younger children out of school, or raising the entrance age, which we know at best are short-term solutions and at worst harm individual children and contribute to inappropriate expectations" (Bredekamp & Shepard, 1989, p. 23). Naturally the ultimate test of a screening battery is the usefulness of the information it provides.

There are many articles in which the importance of early intervention is discussed in preventing reading problems (Clay, 1985; Felner & Felner, 1989; Hawkins, 1985; Kilby, 1984). There are also articles in which kindergarten screening is used to predict kindergarten failure (Ireton, Shing-Lun & Kampen, 1981), first grade readiness (Gallerani, O'Regan & Reinherz, 1982), first grade achievement (Harrison & Naglieri, 1981) and even second grade achievement (Gordon, 1988).

Few articles examine the use of screening tests to identify reading problems in kindergartners. One article by Nathlie Badian (1982) did examine the possibility of predicting reading levels before

kindergarten. Her data supported the view that " . . . early identification (before kindergarten, if possible), followed by early special help in reading readiness and reading skills, has a beneficial effect in reducing the incidence of reading disability" (Badian, 1982, p. 317).

Using kindergarten screening scores to predict the need for early reading intervention has not been examined fully; and it was this area on which our study focused.

Background of Kindergarten Screening

There was no kindergarten screening done in the spring of 1975 at the school where I (Crail) began teaching kindergarten. Typically, schools took all those children who were five years old before October 30th and even some four-year old children with early entrance permission. Kindergarten was not required in Ohio at that time. In some districts, kindergarten did not even have an official course of study. Kindergarten was simply a bridge between home and school. Kindergartners worked on colors, numbers and the alphabet, but mostly students had fun playing and working together.

During my (Crail) eleven-year tenure as a kindergarten teacher many changes occurred. The district begin screening all those coming into kindergarten to assess if they were ready. Early entrance for four-year old children became almost unthinkable. The school not only had an official course of study for kindergarten, it had three workbooks for the students to complete and 20 or more Pupil Performance Objectives were established to guide instruction.

In 1975, Public Law 94-142 was passed requiring assessment of all children entering kindergarten. The "Education for all Handicapped Children's Act" required health, vision, hearing, language, motor functioning, social and emotional functioning to be assessed (Gallerani, 1982). Schools began kindergarten screening to comply with this law. The rapid expansion of screening batteries became a real concern to psychologists and educators. Since the use of preschool assessment was mandated, what instruments to use became a major question.

New programs began to emerge to try to meet the needs of all students. There were increased provisions

for pre-kindergarten programs. Later school entrance age, developmental placement, trial placement and a continuous progress plan with multi-age groupings became fashionable (Charlesworth, 1989).

Use of kindergarten screening tests

Screening began as a procedure to help identify children who might have special needs in kindergarten (Moilanen, 1987). Through the years the developmental stage of the child became a concern. Children needed to be "ready" before they came to kindergarten. Through my (Crail) experience, it appears to me that the expanded need for child care for employed families had a big impact on readiness. Many of the children had a higher degree of readiness than before, mostly as a direct result of preschool experiences. Those children perceived as not being ready were directed to delay entry into school and to attend a quality pre-school as a socializing activity. Many public schools have started offering pre-kindergarten classes, even though successful completion of kindergarten only became mandatory in Ohio in the fall of 1990. The expectations in kindergarten have become increasingly high and perhaps unrealistic for some (Charlesworth,

1989).

With Ohio Law 99-457, public schools now must begin serving handicapped three- and four-year old children. This requirement will undoubtedly make preschool screening an even more strongly debated topic. Intervention before entrance into kindergarten may become common.

Identifying preschool children who are at risk for school failure is very demanding for any screening instrument. A study by Aronhalt (1990) indicated that the Ashland City kindergarten screening test results had limited predictability of 1st and 2nd grade academic achievement. Aronhalt stated, however, th: the screening items found to have a statistically significant influence on academic achievement were the perceptual development, ABC Inventory and fine motor scores, (Aronhalt, 1990).

In several other studies, individual screening tests that are currently being used by the Ashland City Schools and many other districts have been shown to have that predictive component. They are: motor activity, mother's education, speech development, speech problems, age, preschool, coordination,

language, alphabet, letter recognition, perceptual development, ABC Inventory, fine motor and number comprehension (Aronhalt, 1990; Gallerani, O'Regan & Reinherz, 1982; Gordon, 1988; Ireton, Shing-Lun & Kapen, 1981). The study of these subtests plus any combinations of subtests may tell us more about the predictiveness of the Ashland Screening Battery. As stated by Short and Fincher (1983), "Future research should continue to explore the inter-relationship of items on screening instruments to obtain valid and reliable preschool diagnostics" (p. 181).

This study investigated the possibility that some combinations of Ashland's preschool scoring subtests may prove to be accurate predictors of future need for reading intervention.

Setting and Subjects

The Ashland City Schools are located in Ashland, Ohio. Ashland is a small city of 22,000 people. It has a diverse economic base consisting of agriculture, small industry, and it is a university community as well as the county seat.

The Ashland City Schools enroll 4,167 students in grades kindergarten through twelve. There are seven

elementary school (K-6), one junior high school (7-8), and one high school (9-12). Over nine percent of the students receive assistance from the Aid to Dependent Children program (ADC) and 22 percent of the students are eligible for free or reduced priced lunches (Cox, 1989).

The initial selecting of students included 243 second-grade students from the seven Ashland City School elementary schools. The research group consisted of 113 males and 130 females. The 243 second-grade students were selected since they had completed the Ashland City Schools' Kindergarten Screening Battery in 1988; and they had been classified by the beginning of first grade into those needing reading intervention and those not needing intervention.

Variables

Dependent variables.

The dependent variable in this study was a dichotomous variable which indicated whether each student did or did not qualify for the first-grade reading intervention program. A student qualified for intervention by scoring below the 36th percentile on

the standardized Iowa Test of Basic Skills (Hieronymus, A. Hoover, H. & Lindquist, E., 1986) given in kindergarten or through teacher recommendation and scoring below the 36th percentile on the Gates-MacGinitis Reading Test (MacGinitis, W. & MacGinitis, R., 1989) in first grade. A value of 1 was assessed to those students who qualified for the reading intervention program; and a value of 0 was given to the students who did not qualify.

Independent variables

The independent variables consisted of four kindergarten screening subtest scores: (a) gross motor scores, (b) perceptual scores, (c) fine motor scores, (d) ABC Inventory scores. Each of the four subtests were scored on a scale ranging from 1 to 3, with the value of 1 representing a lower level of performance.

The gross motor subtest was designed to measure the child's ability to identify body parts and the child's degree of large muscle coordination. The measurement was obtained by volunteers from a local university. A child's perceptual score was obtained through the administration of the Visual-Motor Integration Developmental Test (Beery, & Buktenica,

1967). This test was given by the school psychologist. The fine motor subtest assessed the child's ability to handle writing materials and manipulatives. The observations of the children were made by school guidance counselors in groups of two to four students. Each child was evaluated with the ABC Inventory (Adair, & Blesch, 1965). The kindergarten teacher conducted this general knowledge assessment.

Methodology

The purpose of this study was to determine if the kindergarten screening subtest scores could be used to predict which students would qualify for the first-grade reading intervention program. Since the dependent variable consisted of two categories, the data were analyzed with a logit regression model. (Judge, Griffiths, Hill, Lutkepohl & Lee, 1985; Hosmer & Lemeshow, 1989). See Table 1 for a listing of the variables used in the logit regression model.

Insert Table 1 about here

The sample of 243 students was randomly divided into two groups. One group that consisted of 121

students was analyzed with the logit regression model. The descriptive statistics for this group are listed in Table 2. The remaining 122 students formed a holdout group that was used to cross-validate the logit regression model. The mean values of the independent variables for the two groups--the group being analyzed and the group that served as the holdout group--did not differ at the .05 level or significance.

Insert Table 2 about here

Five steps were used to evaluate how well the logit regression model that contained the four subtests was able to classify students. First, chi-square value of the difference between the quantities of -2 times the observed likelihood of the model that contained only the constant term and -2 times the observed likelihood of the model that contained the constant term and the four independent variables was tested. This chi-square value was used to determine whether the null hypothesis that all of the coefficients of the independent variables were equal to 0 should be rejected.

Second, the Wald test, which is the square of the ratio of the coefficient to the standard error, was used to test whether each coefficient differed from 0.

Third, the maximum chance criterion of correctly classifying students was used. This criterion requires that the proportion of students correctly classified by the model must be greater than the proportion of students in the largest group. We required the percent of students correctly classified by the model had to be 25 percent greater than the maximum chance criterion value (Hair, Anderson, & Tatham, 1987).

Fourth, the proportional chance criterion of correctly classifying students was also applied to the model. In the proportional chance criterion the proportion of students correctly classified by the model must be greater than the sum of the squares of the proportion of students in the two groups. Again, we required the percent of students correctly classified by the model to be 25 percent greater than the proportional chance criterion value.

Finally, we thought that it was critical for the model to be able to accurately identify those students who would qualify for the reading intervention program.

Thus, the fifth criterion used required that the model be able to correctly identify at least two-thirds of the students who would qualify for the reading intervention program.

Results

The analyses of the logistic regression model are contained in Table 3. The chi-square value used to test the null hypothesis that all of the four coefficients of the independent variables were equal to 0 was 27.054. Since this value was statistically significant at the .01 level, the null hypothesis was rejected.

Insert Table 3 about here

An examination of the Wald test used to test the four coefficient values indicated that only one null hypothesis could be rejected. Only the Wald test for the ABC Inventory scores was statistically significant at the .01 level. Therefore, only the ABC Inventory scores had a statistically significant impact on the classification of the students. Table 4 contains the information regarding the model's ability to accurately

classify the students in the holdout group. Sixty of the 67 students (89.6%) who did not qualify for the reading intervention program were correctly identified. Twenty-five of the 55 students (45.4%) who did qualify for the program were accurately classified by the logit model. Thus, 85 of the total of 122 students (69.7%) were correctly classified by the model.

Insert Table 4 about here

The maximum chance criterion, which is equal to the proportion of students in the holdout group who did not qualify for the program, was .55. The proportion of students who were correctly classified by the model (.697) was slightly in excess of the figure that is 25 percent higher than the .55 criterion (.69).

The proportional chance criterion value was .63. Again, the proportion of students accurately classified (69.7%) by the model exceeded the figure that is 25 percent more than the proportional criterion (.63). As indicated by the percent of students classified correctly for each group, the model was much better at identifying students who did not qualify for the

program (89.6%) than the students who did qualify (45.4%). Since the model could correctly identify less than one half of the students in the group who qualified for the program, the model did not meet the criterion of correctly classifying at least two-thirds of those students in the holdout group.

The school administrators may find the results of the model useful even though the model was able to correctly identify only approximately one half of the students who would eventually qualify for the reading intervention program. If identification of a portion of the students who would eventually need reading assistance was acceptable, the model could be used.

The identification of the students who would eventually qualify for the program could be made by multiplying each of the four scores of a given student by each of its respective coefficients in the model and adding the constant to the sum of those products. Dividing the natural log of this sum by 1 plus the natural log of the value would give the predicted probability that the student would belong to the group of students who would qualify for the first-grade reading intervention program. If this probability

exceeds .50 the student would be identified as needing reading intervention.

To illustrate, assume a student received scores of 2 on each of the subtests. The student's predicted value would be calculated as follows from the coefficient values listed in Table 3:

$$y = 4.323 - .405(2) - .279(2) - .421(2) - 1.139(2)$$

$$y = -.165$$

The probability that the student would qualify for the first-grade reading intervention program would be calculated as follows:

$$p = \frac{e^{-.165}}{1+e^{-.165}} = .46$$

Since the probability is less than .5, the student would not be classified as one who would eventually qualify for the first-grade reading program.

Conclusions

This study examined the ability of four kindergarten screening subtests to identify which students would qualify for the first-grade reading intervention program. The scores were analyzed with a logit regression model. The results of the analysis indicated that the four subtest scores correctly

identified 69.7 percent of the students in the holdout group. Nearly 90% of the students in the holdout group who did not qualify for the reading intervention program were correctly classified by the model. Less than one half (45.4%) of the students who qualified for the program, however, were correctly classified by the model.

The logit regression model could be used by the school system if accurately identifying approximately one half of the students who would eventually qualify for the first-grade reading intervention program was acceptable. If a higher level of accuracy is deemed necessary, additional information regarding each student would be needed before the required level of accuracy could be met.

It may be that the earliest a student could reliably be identified as needing a reading intervention program is during the first semester of kindergarten. Information on students obtained throughout the first half of the year by the kindergarten teacher may prove to be essential information for early reading intervention placement. This avenue of investigation is worthy of further study

since expedient and proper placement of children is an important educational goal.

Table 1

Variables Used in the Logit Regression Model

Variables Used in the Study

Variable	Symbol	Range of Values
Group Membership	Y	0 = did not qualify for program 1 = did qualify for program
Groups Motor Subtest Score	X_1	1-3
Perception Subtest Score	X_2	1-3
Fine Motor Subtest Score	X_3	1-3
ABC Inventory Subtest Score	X_4	1-3

Table 2

Descriptive Statistics for the Variables for the Group Analyzed by the Logit Regression Model

Variable	Mean	Standard Deviation
Y	.37[a]	---
X_1	2.44	.59
X_2	1.94	.67
X_3	2.03	.55
X_4	2.26	.71

[a] Indicates that 37% of the students qualified for the program.

Table 3

Logit Regression Model

Variable	Coefficient	S.E.	Wald	DF	Sig
X_1	- .405	.379	1.145	1	.285
X_2	- .279	.381	.537	1	.464
X_3	- .421	.437	.926	1	.336
X_4	-1.139	.357	10.188	1	.001
Constant	4.323	1.218	12.605	1	.0004

-2 log likelihood for the full model 132.656

-2 log likelihood for model with constant only 159.710

Model chi-square = 27.054 df = 4 sig = .0000

Table 4

Correct Classification for the Holdout Group with the Logit Regression Model

		Predicted Group Membership		Total	%
		Did Not Qualify	Did Qualify		
Actual Group Membership	Did Not Qualify	60	7	67	89.6
	Did Qualify	30	25	55	45.4
	Total	90	32	122	69.7

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